UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
REGION III
1650 Arch Street
Philadelphia, Pennsylvania 19103-2029

Mr. Alan Pollock, Acting Director
Division of Water Quality Programs
Virginia Department of Environmental Quality
629 Main Street
Richmond, VA 23219

Dear Mr. Pollock:

The United States Environmental Protection Agency (EPA) Region III is pleased to approve the Total Maximum Daily Loads (TMDLs) for the aquatic life (benthic) use impairments on Twittys Creek and Hurricane Branch Unnamed Tributary. The TMDLs were submitted to EPA for review in April 2004. The TMDLs were established and submitted in accordance with Section 303(d)(1)(c) and (2) of the Clean Water Act to address an impairment of water quality as identified in Virginia's 1998 Section 303(d) list.

In accordance with Federal regulations at 40 CFR §130.7, a TMDL must comply with the following requirements: (1) designed to attain and maintain the applicable water quality standards, (2) include a total allowable loading and as appropriate, wasteload allocations (WLAs) for point sources and load allocations for nonpoint sources, (3) consider the impacts of background pollutant contributions, (4) take critical stream conditions into account (the conditions when water quality is most likely to be violated), (5) consider seasonal variations, (6) include a margin of safety (which accounts for uncertainties in the relationship between pollutant loads and instream water quality), (7) consider reasonable assurance that the TMDL can be met, and (8) be subject to public participation. The enclosure to this letter describes how the TMDLs for the aquatic life use impairments satisfy each of these requirements.

Following the approval of these TMDLs, Virginia shall incorporate the TMDLs into the appropriate Water Quality Management Plans pursuant to 40 CFR § 130.7(d)(2). As you know, all new or revised National Pollutant Discharge Elimination System permits must be consistent with the TMDL WLA pursuant to 40 CFR §122.44 (d)(1)(vii)(B). Please submit all such permits to EPA for review as per EPA's letter dated October 1, 1998.

If you have any questions or comments concerning this letter, please don't hesitate to contact Mr. Peter Gold at (215) 814-5236.

Sincerely,

Jon M. Capacasa, Director
Water Protection Division

Enclosure

Decision Rationale

Total Maximum Daily Loads for the Aquatic Life Use Impairments on Twittys Creek and Hurricane Branch Unnamed Tributary

I. Introduction

The Clean Water Act (CWA) requires a Total Maximum Daily Load (TMDL) be developed for those water bodies identified as impaired by a state where technology-based and other controls will not provide for attainment of water quality standards. A TMDL is a determination of the amount of a pollutant from point, nonpoint, and natural background sources, including a margin of safety (MOS), that may be discharged to a water quality-limited water body.

This document will set forth the Environmental Protection Agency's (EPA) rationale for approving the TMDLs for the aquatic life use (benthic) impairments on Twittys Creek and Hurricane Branch Unnamed Tributary (UT Hurricane Branch). EPA's rationale is based on the determination that the TMDLs meet the following eight regulatory conditions pursuant to 40 CFR §130.

1) The TMDLs are designed to implement applicable water quality standards.
2) The TMDLs include a total allowable load as well as individual waste load allocations and load allocations.
3) The TMDLs consider the impacts of background pollutant contributions.
4) The TMDLs consider critical environmental conditions.
5) The TMDLs consider seasonal environmental variations.
6) The TMDLs include a margin of safety.
7) There is reasonable assurance that the TMDLs can be met.
8) The TMDLs have been subject to public participation.

II. Background

The 20,000 acre Twittys Creek Watershed is located in Charlotte County, Virginia. Twittys Creek is a tributary to Roanoke Creek. The impaired segment runs 7.25 miles from the West Point Stevens Drake Discharge to its confluence with Roanoke Creek. The 2,000 acre UT Hurricane Branch Watershed is located in Nottoway County Virginia. The impaired segment runs 1.12 miles from the Town of Blackstone Sewage Treatment Plant (STP) discharge to its confluence with Hurricane Branch. Hurricane Branch is located in the Chowan River Dismal Swamp Basin. Agricultural and forested lands comprise most of the lands in each watershed. These lands make up 90 percent of the Twittys Creek Watershed and 66 percent of the UT Hurricane Branch Watershed. Developed lands represent 34 percent of the UT Hurricane Branch

Watershed and a small portion of the Twittys Creek Watershed (1 percent). The remainder of the Twittys Creek Watershed is composed of wetlands and barren lands.

In response to Section 303(d) of the CWA, the Virginia Department of Environmental Quality (VADEQ) listed Twittys Creek (VAC-L39R) and UT Hurricane Branch (VAC-K16R) on Virginia's 1998 Section 303(d) list as being unable to attain the general standard for the aquatic life use. The failure to attain this use on each stream was determined through biological assessments of the benthic macroinvertebrate community.

Virginia's 305(b)/303(d) guidance states that support of the aquatic life beneficial use is determined by the assessment of conventional pollutants (dissolved oxygen (DO), pH, and temperature); toxic pollutants in the water column, fish tissue, and sediments; and biological evaluation of benthic community data.[1] Therefore, a biological assessment of the benthic community can be used to determine a stream's compliance with the state's general standard for the aquatic life use. Virginia uses EPA's Rapid Bioassessment Protocol II (RBPII) to determine status of a stream's benthic macroinvertebrate community.[2] This approach evaluates the benthic macroinvertebrate community between a monitoring site and its reference station. Measurements of the benthic community, called metrics, are used to identify differences between monitored and reference stations.[3] The state is currently in the process of changing this methodology to a stream condition index (SCI) approach.

As part of the RBPII approach, reference stations are established on streams which are minimally impacted by humans and have a healthy benthic community. These reference stations represent the desired community for the monitored sites. Monitored sites are evaluated as non-impaired, slightly impaired, moderately impaired, or severely impaired based on a comparison of the biological community of the reference and monitored sites. Streams that are classified as moderately (after a confirmatory assessment) or severely impaired after an RBPII evaluation are classified as impaired and are placed on the Section 303(d) list of impaired waters.

The reference stations for Twittys Creek are located in upstream nonimpaired portions of the watershed. The monitoring stations ATWT003.36 and ATWT006.40 have been evaluated as being moderately impaired compared to the reference station consistently since 1995. Similar to the impairment on Twittys Creek the biological monitoring stations on UT Hurricane Branch have been evaluated as moderately impaired since 1995. The reference station for the biological monitoring stations on both streams were evaluated as impaired using Virginia's SCI as well.

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[1]VADEQ. 1997. 1998 Water Quality Assessment Guidance for 305(b) Water Quality Report and 303(d) TMDL Priority List Report. Richmond, VA.

[2]Tetra Tech 2002. Total Maximum Daily Load (TMDL) Development for Blacks Run and Cooks Creek. Fairfax, Virginia.

[3]Ibid 2

The RBPII analysis assesses the health of the macroinvertebrate community of a stream. The analysis will inform the biologist if the stream's benthic community is impaired. The benthic assessment in and of itself is usually unable to provide enough information for the biologist to determine what is causing the degradation of the benthic community. Although information can be gleaned from knowing the needs of the species within the impaired segment. Certain species for example are more tolerant or less tolerant of metals and sediment than others. Often, additional analysis is required to determine the pollutants which are causing the impairment.

TMDL development requires the identification of impairment causes and the establishment of numeric endpoints that will allow for the attainment of designated uses and water quality criteria.[4] A reference watershed approach was used to determine the stressors and the endpoints for the Twittys Creek and UT Hurricane Branch TMDLs. Numeric endpoints represent the water quality goals that are to be achieved through the implementation of the TMDLs which will allow the impaired waters to attain their designated uses. A reference watershed approach is based on selecting a non-impaired watershed that shares similar landuse, ecoregion, and geomorphological characteristics with the impaired watershed. The stream conditions and loadings in the reference water are assumed to be the conditions needed for the impaired water to attain standards.

To determine whether a stream was a suitable reference site for the monitored sites, the modelers evaluated the topography, soils, ecoregion, landuses, watershed size, and point source inventory of the potential reference site. A reference site candidate was removed if it was identified as moderately or severely impaired in the biomonitoring analysis. The Upper Twittys Creek Watershed was selected as the reference watershed for both waters.

The next step in the TMDL development process was to determine the loadings and stressors in the monitored and reference watersheds. Low DO, sedimentation, habitat modification, nutrients, and toxic pollutants were evaluated as possible stressors to the monitored streams. Ambient water quality monitoring on the streams documented temperature, DO, pH, turbidity, total suspended solids (TSS), nitrogen, and phosphorous. Also discharge monitoring reports (DMRs) were evaluated for point sources discharging within the impaired waters. The DMRs indicated that these facilities were operating within their permit limits.

To get a better understanding of the DO concentrations on Twittys Creek during the most critical periods, diurnal DO sampling was conducted on August 14-15, 2003. During this study, DO concentrations were monitored hourly over a 24-hour period at the two impaired and the upstream reference stations. These samples were taken in the summer when the lowest DO concentrations are expected to be found due to a combination of high water temperatures (lower solubility of oxygen) and low flows. The diurnal DO data also captures the impacts of respiration from primary producers on the stream system. During the evening and early morning

[4]Ibid 2

hours, these organisms cease photosynthetic operations since there is no sunlight available and consume oxygen. All of the samples collected during this period had DO concentrations in compliance with the applicable criteria. The lowest concentrations were detected in the early morning hours. This is expected since it is just before the daylight hours. Since there were no observed violations of the DO criteria, nutrients were removed as a possible stressor as well. Since the impacts of excessive nutrient loadings often manifest in low DO levels.

Toxicity testing was conducted for water samples collected from Twittys Creek as well. The testing compared the survival and growth rates or fathead minnows (Pimephales promelas) and water fleas (Ceriodaphnia dubia) in water collected from the impaired site with an unimpaired water source. The test did not document any statistically significant effects associated with fathead minnows or water fleas reared in water from Twittys Creek. Therefore, chronic toxicity was ruled out as a possible stressor to the watershed.

Sediment was identified as the stressor of concern for the Twittys Creek watershed for several reasons. The impaired stations on Twittys Creek had lower sedimentation and embeddedness scores that the upstream nonimpaired reference sites. Degraded banks were seen at several locations in the watershed indicating that the stream was excessively eroding its own banks and bringing this sediment load into the system.

Sediment was identified as the pollutant that needed to be controlled on the UT Hurricane Branch as well. However, sediment was not seen as the stressor of concern, hydrologic alteration was. Impervious surfaces associated with urbanized area do not allow stormwater to infiltrate into the ground. These surfaces often channel sheets of water into streams and other waterbodies. Large volumes of water are brought into the stream more rapidly than in a more natural setting. In order to carry this increased volume of water, the stream's flow and velocity increase which causes it to often erode its own channel and banks which detrimentally impacts the benthic community. In order to reduce the sediment load, the large volumes of water will need to be reduced as well.

The next step in developing these TMDLs was to determine the sediment (the stressor) loadings to the monitored and reference segments. The Generalized Watershed Loading Functions (GWLF) model was selected as the means to determine loadings to the streams. The GWLF model provides the ability to simulate runoff, sediment, and nutrient loadings from watersheds given variable source areas (e.g., agricultural, forested, and developed land).[5] GWLF is a continuous simulation model that uses daily time steps for weather data and water balance calculations.[6] Calculations are made for sediment based on daily water balance totals that are summed to give monthly values. The size of the reference watershed (Upper Twittys Creek) was adjusted to the size of the impaired watersheds (Twittys Creek and UT Hurricane Branch) as

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[5]Ibid 2

[6]Ibid 2

watershed size impacts the carrying capacity of the water. Each of the landuses within the reference watershed were adjusted in equal proportion to insure the landuse breakdown remained constant.

Local rainfall and temperature data were needed to simulate the hydrology. The Camp Pickett weather station was used for these TMDLs. Since there were no streamflow gauges within either watershed, the models were calibrated to a separate watershed with a gauge and transferred to the impaired watershed, adjustments were made to address differences in landuses. The annual modeled sediment load to the reference watershed was used as the endpoint for both impaired waters. The modeled loadings to the impaired waters were lowered until the matched those of the reference watershed.

Table 1 - Summarizes the Sediment Allocations for Twittys Creek and UT Hurricane Branch

Stream	Pollutant	TMDL	WLA	LA	MOS*
Twittys Creek	Sediment (tons/yr)	890	20	780	89
UT Hurricane Branch	Sediment	144	60	69	14

* Virginia includes an explicit MOS by reserving the 10 percent of total loading to the MOS.

The United States Fish and Wildlife Service has been provided with copy of these TMDLs.

III. Discussion of Regulatory Conditions

EPA finds that Virginia has provided sufficient information to meet all of the eight basic requirements for establishing aquatic life use (benthic) impairment TMDLs for Twittys Creek and UT Hurricane Branch. EPA is therefore approving these TMDLs. EPA's approval is outlined according to the regulatory requirements listed below.

1) The TMDLs are designed to meet the applicable water quality standards.

The impaired segments were listed as impaired due to a degradation of their benthic macroinvertebrate communities. As mentioned above, benthic assessments inform the biologist of an impairment, but they are unable to identify stressors conclusively. Therefore, further analysis was required to determine the potential stressors. Virginia has indicated that excessive levels of sediment has caused the degradation of the benthic communities in Twittys Creek and hydrologic alteration has impacted the benthic community of UT Hurricane Branch. The Commonwealth does not have numeric standards for sediment at this time. Therefore, the loadings obtained from the reference watershed were used as the endpoints for these TMDLs. Its believed that if these streams can reduce their sediment loadings to that of the area weighted reference watershed, the impairment to the benthic communities will be relieved.

The GWLF model was used to determine the loading rates of the sediment to the streams from all point and nonpoint sources. The TMDL modelers determined the applicable stressor loading rates within each watershed. Data used in the model was obtained on a wide array of items, including landuses in the area, point sources in the watershed, weather, stream geometry, etc..

The GWLF model provides the ability to simulate runoff and sediment loadings from watersheds given variable source areas (e.g., agricultural, forested, and developed land). GWLF is a continuous simulation model that uses daily time steps for weather data and water balance calculations.[7] The reference watershed's area was adjusted to equal that of the impaired waters. The percent of each land use within the reference waters remained constant. In the GWLF model, the nonpoint source load calculation is affected by terrain conditions, such as the amount of agricultural land, land slope, soil erodibility, and farming practices used in the area.[8] Parameters within the model account for these conditions and practices.

EPA believes that using GWLF to model and allocate the sediment loadings to the impaired stream segments will ensure the attainment of the designated uses and water quality standards on these streams.

2) The TMDLs include a total allowable load as well as individual waste load allocations and load allocations.

Total Allowable Loads

Virginia indicates that the total allowable loading is the sum of the loads allocated to land based precipitation driven nonpoint source areas (forest and agricultural land segments) and point sources. Activities that increase the levels of nutrients and sediment to the land surface or their availability to runoff are considered flux sources. The actual value for total loading can be found in Table 1 of this document. The total allowable load is calculated on an annual basis.

Waste Load Allocations

There are three facilities holding National Pollutant Discharge Elimination System (NPDES) permits in the Twittys Creek and UT Hurricane Branch Watersheds. These three facilities are treatment plants and permitted or design flow and sediment concentrations values are documented within their permits. The WLAs for these facilities can be determined by multiplying their permitted flow by their permitted concentration of sediment by 365 days after making the appropriate unit conversions. The WLAs for the non-stormwater permits are provided in Table 2.

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[7]Ibid 2

[8]Ibid 2

EPA regulations require that an approvable TMDL include individual waste load allocations (WLAs) for each point source. According to 40 CFR 122.44(d)(1)(vii)(B), "Effluent limits developed to protect a narrative water quality criterion, a numeric water quality criterion, or both, are consistent with assumptions and requirements of any available WLA for the discharge prepared by the state and approved by EPA pursuant to 40 CFR 130.7." Furthermore, EPA has authority to object to the issuance of any NPDES permit that is inconsistent with the WLAs established for that point source.

Table 2 - TSS WLAs for Twittys Creek and UT Hurricane Branch

Facility	Stream	Permit Number	Permit Load
West Point Stevens	Twittys Creek	VA0050822	16.8
Drakes Branch STP	Twittys Creek	VA0084433	3.6
Blackstone STP	UT Hurricane Branch	VA0025194	60

Load Allocations

According to Federal regulations at 40 CFR 130.2(g), load allocations (LAs) are best estimates of the loading, which may range from reasonably accurate estimates to gross allotments, depending on the availability of data and appropriate techniques for predicting loading. Wherever possible, natural and nonpoint source loads should be distinguished.

In order to accurately simulate landscape processes and nonpoint source loadings, VADEQ used the GWLF model to represent the impaired watersheds. The GWLF model is a comprehensive modeling system for the simulation of watershed hydrology, point and nonpoint source loadings, and receiving water quality. GWLF uses precipitation data for continuous and storm event simulation to determine total loading to the impaired segments from the various landuses within the watershed. Table 3 provides the LA for all of the nonpoint sources of sediment.

Table 3 - LA for Sediment for Twittys Creek and UT Hurricane Branch

	Twittys Creek		UT Hurricane Branch	
Land Use	LA Sediment (tons/yr)	Percent Reduction	LA Sediment (lbs/yr)	Percent Reduction
Forest	118	0	10	0
Pasture/Hay	247	30	8	67
Row Crop	99	30	N/A	0

Low Intensity Residential	0.7	30	0.8	67
Commercial	11	30	33	67
Transitional	247	30	N/A	0
Streambank Erosion	56.2	30	17	67

3) The TMDLs consider the impacts of background pollution.

The reference watershed approach inherently considers the impact of background pollutants by considering the sediment load from all landuses, including forested lands, within the impaired and reference watersheds.

4) The TMDLs consider critical environmental conditions.

According to EPA's regulation 40 CFR 130.7 (c)(1), TMDLs are required to take into account critical conditions for stream flow, loading, and water quality parameters. The intent of this requirement is to ensure that the water quality of the impaired segments is protected during times when it is most vulnerable.

Critical conditions are important because they describe the factors that combine to cause a violation of water quality standards and will help in identifying the actions that may have to be undertaken to meet water quality standards[9]. Critical conditions are a combination of environmental factors (e.g., flow, temperature, etc.), which have an acceptably low frequency of occurrence. In specifying critical conditions in the waterbody, an attempt is made to use a reasonable "worst-case" scenario condition. For example, stream analysis often uses a low-flow (7Q10) design condition when the ability of the waterbody to assimilate pollutants without exhibiting adverse impacts is at a minimum.

The GWLF model was run over a multi-year period for the reference watershed to insure that it accounted for wide range of climatic conditions within the reference watershed. The allocations developed in the TMDLs will therefore insure that the criteria is attained over a wide range of environmental conditions.

5) The TMDLs consider seasonal environmental variations.

Seasonal variations involve changes in stream flow and loadings as a result of hydrologic and climatological patterns. In the continental United States, seasonally high flows normally

[9]EPA memorandum regarding EPA Actions to Support High Quality TMDLs from Robert H. Wayland III, Director, Office of Wetlands, Oceans, and Watersheds to the Regional Management Division Directors, August 9, 1999.

occur in early spring from snow melt and spring rain, while seasonally low flows typically occur during the warmer summer and early fall drought periods. Pollutant loadings also change during the year as vegetation grows making it more difficult for sediments to runoff. Consistent with the discussion regarding critical conditions, the GWLF model and TMDL analysis effectively considered seasonal environmental variations through the use of observed weather data over an extended period of time and modifying the soil loss equations based on the time of the year.

6) The TMDLs include a margin of safety.

This requirement is intended to add a level of safety to the modeling process to account for any uncertainty. The MOS may be implicit, built into the modeling process by using conservative modeling assumptions, or explicit, taken as a percentage of the WLA, LA, or TMDL. Virginia includes an explicit MOS by allocating 10 percent of the total TMDL loading to the MOS.

7) There is a reasonable assurance that the TMDLs can be met.

EPA requires that there be a reasonable assurance that the TMDLs can be implemented. WLAs will be implemented through the NPDES permit process. According to 40 CFR 122.44(d)(1)(vii)(B), the effluent limitations for an NPDES permit must be consistent with the assumptions and requirements of any available WLA for the discharge prepared by the state and approved by EPA. Furthermore, EPA has authority to object to issuance of an NPDES permit that is inconsistent with WLAs established for that point source.

Nonpoint source controls to achieve LAs can be implemented through a number of existing programs such as Section 319 of the CWA, commonly referred to as the Nonpoint Source Program.

8) The TMDLs have been subject to public participation.

There were two public meetings held for each of these TMDLs. The meetings were noticed in the Virginia Register and open to a thirty-day comment period. Written comments were received for both TMDLs. DEQ responded to all of the written comments. Table 4 identifies the dates and locations of the meetings.

Stream	Public Meeting #1	Public Meeting #2
Twittys Creek	Charlotte Court House 10/21/03	Town of Blackstone 11/13/03
UT Hurricane Branch	Charlotte Court House 03/03/04	Town of Blackstone 03/02/04